



Atty. Ref. No. 030974

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Group Art Unit: 1625

Examiner: Oh, Taylor V.

In re application of:

MOORE *et al.*

Serial No.: 09/955,672

Filed: September 19, 2001

**Process for the Production of  
Anhydrosugar Alcohols**

I hereby certify that the correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to:  
Commissioner for Patents, P.O. Box 1450,  
Alexandria, Virginia 22313-1450

*John C. Kremoneos*  
2/3/04 Buchanan Ingersoll, PC

Date

**BRIEF ON APPEAL**

To: Mail Stop - Appeal Brief - Patent  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Applicants/Appellants hereby submit this Brief to preserve their rights related to their appeal of the rejection of all of the claims in a Final Action dated October 3, 2003. As detailed below, the Examiner has yet to review an Amendment and Reply Under 37 C.F.R. § 1.116 which was initially filed by Applicants/Appellants on December 3, 2003 ("Amendment").

Applicants/Appellants respectfully request the right to supplement this Brief upon the review by the Examiner of the Amendment.

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**Real Party in Interest**

The real party in interest is Archer-Daniels-Midland Company, a corporation of Delaware and with principal place of business in Illinois, the assignee of the entire right, title, and interest

in and to the above-captioned Application by an assignment recorded in the United States Patent and Trademark Office (USPTO) on December 20, 2002 at Reel 013308, Frame 0497.

**Related Appeals and Interferences**

There are no related appeals.

**Status of Claims**

Claims 1, 4-13 and 16-62 are pending, currently stand rejected, and are on appeal. All the pending claims are reproduced in Appendix 1. Subject to the entry of the Amendment, the pending claims on appeal would be claims 1, 4-13, 17, and 19-64.

**Status of Amendments**

An Amendment and Reply Under 37 C.F.R. § 1.116 ("the Amendment") was filed on December 3, 2003, with any and all necessary fees and requests for extension of time. The Amendment sought cancellation of claims 16 and 18. The Amendment sought amendment of claims 1, 13, 33-35, 59 and 60. The Amendment sought addition of new claims 63 and 64. Many of these claim changes are directed to correcting informalities in the claims.

In a conversation with the Examiner, counsel for the Applicants/Appellants learned that, even though the Patent and Trademark Office acknowledged receipt of the Amendment by virtue of a return post card, the Amendment has not been associated with the application file. Accordingly, the Amendment has not yet been reviewed. Applicants/Appellants forwarded a replacement copy of the Amendment to the Examiner on February 3, 2004 for his review.

It is Applicants'/Appellants' belief that the Amendment is currently being reviewed by the Examiner. Applicants/Appellants have submitted this brief to preserve their rights related to

their appeal of the Final Office Action. Applicants/Appellants respectfully request the right to supplement this Brief upon the review by the Examiner of the Amendment and the entry of any of the claim amendments provided therein.

**Summary the Invention**

The claims on appeal, namely claims 1, 4-13, and 16-62, relate in general to a process for the production of an anhydrosugar alcohol without the use of organic solvents.

**Issues**

Whether the Examiner erred in rejecting claims 1, 4-13, and 16-62 under 35 U.S.C. § 103(a) as being unpatentable over Hartman (U.S. Patent No. 3,454,603) in view of Feldmann (U.S. Patent No. 4,564,692) and Brinegar et al. (PCT Publication No. WO 00/14081).

**Grouping of Claims**

Group I comprises claims 1, 4-13, and 16-62.

**ARGUMENT**

The Examiner rejected claims 1, 4-13, and 16-62 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Hartmann, U.S. Patent No. 3,454,603, in view of Feldmann *et al.*, U.S. Patent No. 4,564,692, and Brinegar *et al.*, PCT Publication No. WO 00/14081. The Examiner maintained that the skilled artisan would have been motivated to incorporate the crystallization technique of Feldmann *et al.* into the Hartmann process of preparing 1,4-3,6-dianhydroglucitol in order to improve the purity of the desired compound. The Examiner further stated that "the Brinegar *et al.* [reference] has been used to the tertiary reference to supplement the primary reference regarding the teaching of AG50W-X12 acidic catalyst useful for producing anhydro sugar alcohols with no residue." Applicants/Appellants respectfully traverse this rejection.

In order to make a *prima facie* case of obviousness, *inter alia*, there must be some suggestion or motivation in the references cited by the Examiner to combine reference teachings to obtain Applicants'/Appellants' invitation. *In re Rouffet*, 149, F.3d 1350, 1357, 47 USPQ2d 1453, 1457-58 (Fed. Cir. 1998). Applicants/Appellants submit that there neither a suggestion nor any motivation for one skilled in the art would to combine the Hartmann and Feldmann *et al.* references.

The claimed invention does not require the use of an organic solvent during the reaction stage. Hartmann teaches only a simple acid catalyzed dehydration and does not teach or suggest the use of a solid acid catalyst without the need for solvent. Moreover, Feldmann *et al.* do not teach that the need for use of a solvent in the dehydration or purification steps can be eliminated. In the claimed process, solvents are not required in either the dehydration or purification steps. Furthermore, unlike Feldmann *et al.*, the claimed invention does not require a concentrated aqueous solution or seed crystals, again eliminating the need for solvent.

While the Examiner asserted that "the skilled artisan in the art would expect to improve on the purity of desired compound by applying the Feldmann *et al.* crystallization technique to the Hartmann process", Hartmann teaches that "[t]he 1,4-3,6-dianhydro-D,L-glucitol (i.e., isosorbide] is of such a nature that it is not readily crystallized, thus *crystallization is not used as a method to purify 1,4,-3,6-dianhydro-D,L-glucitol.*" Col. 2, 1. 71-col. 3, 1. 3) (emphasis added). Thus, the teachings of Feldmann *et al.* that crystallization should be used to purify isosorbide directly contradict the teachings of Hartmann that crystallization is *not* to be used as a method to purify isosorbide. Since the teachings of Hartmann contradict the teachings of Feldman *et al.*, one of ordinary skill in the art would not have been motivated to combine the teachings of the two references to develop the process of the present invention. See *W. L. Gore*

& Assoc. v Garlock, Inc., 721 F.2d 1540, 1550 (Fed. Cir. 1983) (error to find obviousness where references "diverge from and teach away from the invention at hand").

Even assuming, *arguendo*, that one of skill in the art would have been motivated to combine Hartmann and Feldmann *et al.*, he would not have arrived at the claimed invention because he would have used solvents for both the dehydration and purification steps. As set forth above, the claimed process does not use solvents in either the dehydration or purification steps.

With respect to the Brinegar *et al.* reference, the Examiner previously stated that it would have been obvious to the skilled artisan in the art to have [been] motivated to use the Brinegar *et al.* AG50W-X12 as a substitute [acidic catalyst]. This is because the skilled artisan would expect to improve on the purity of the desired compound by using the AG50W-X12 catalyst in the process." Applicants respectfully disagree.

Brinegar *et al.* teach use of AG50W-X12 catalyst in a dehydration step that uses organic solvents. However, Brinegar *et al.* do *not* teach dehydration in the absence of solvent. As such, the Brinegar *et al.* reference fails to remedy the deficiencies of the Hartmann and Feldmann *et al* references since it does not teach or suggest that such a catalyst could be used for dehydration without solvents as in the claimed process. Therefore, one of ordinary skill in the art would not have been motivated to combine Brinegar *et al.* with Hartmann and Feldmann *et al.* to arrive at the *claimed invention*. The Examiner asserted that Feldman *et al.* also teaches a process of obtaining pure anhydrosugar alcohols from the reaction mixtures that have been purified by means of ion exchanges. Therefore, the Feldmann *et al.* [reference] is relevant to the claimed invention.". Applicants/Appellants respectfully disagree. As pointed out above, Feldman *et al.* do not teach that the need for the use of a solvent in the dehydration or purification steps can be eliminated. In particular, Applicants/Appellants point out that one of skill in the art would know

that purification by ion exchange and/or activated carbon, as mentioned in Feldmann et al., requires solvents. The purification step of the claimed process is performed without solvents. As such, Feldmann *et al.* fail to remedy the deficiencies of the cited references, and one of ordinary skill in the art, therefore, would not have arrived at the claimed invention based on Hartmann in view of Feldmann *et al.* and Brinegar *et al.*

Applicants/Appellants respectfully submit that the rejection of claims 1, 4-13 and 16-62 as allegedly unpatentable over Hartmann in view of Feldmann *et al.* (U.S. Patent No. 3,454,603) and Brinegar *et al.* (WO 00/14081) has been overcome and that the Examiner's rejection of those claims under 35 U.S.C. § 103(a) should be reversed.<sup>1</sup>

### **CONCLUSION**

Applicants/Appellants respectfully await receipt of the Examiner's review of the Amendment and Reply Under 37 C.F.R. § 1.116. In the event that any of the claim amendments therein are entered, Applicant/Appellants will supplement this Brief.

In summary, it is respectfully submitted that the prior art of record as construed by the Examiner renders the present claimed invention obvious to one of skill in the art. For the foregoing reasons, the claims on appeal are patentable over each of the cited references and the teaching of the prior art as a whole. Reversal of the rejections and allowance of the appealed claims are respectfully requested.

Enclosed is our check in the amount of \$330.00 to cover the cost of the filing of the Brief on Appeal. Should there be a deficiency in the filing fee not covered by the enclosed check,

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<sup>1</sup> The Amendment which was filed on December 3, 2003 corrects a misspelling present in claims 34, 35, 59 and 60. The Amendment also cures a lack of antecedent basis rejection raised with respect to claims 16 and 18. The changes to these claims made in the Amendment are not reflected in the attached Appendix.

please charge such deficiency to Deposit Account No. 02-4553. This Brief has been filed in triplicate.

Respectfully submitted,  
Buchanan Ingersoll PC



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Date: February 3, 2004

APPENDIX

The claims listed in this Appendix reflect the status of the claims as they existed after the Final Action. The changes to the claims set forth in Applicant's/Appellants' Amendment and Reply Under 37 C.F.R. § 1.116 in response to the Examiner's Final Action have not been included. Upon entry of Applicant's/Appellants' Amendment and Reply Under 37 C.F.R. § 1.116, Applicants/Appellants will supplement this Appendix with a new set of claims. In light of the above comments, the following claims are set forth as follows:

1. A process for the production of an anhydrosugar alcohol, without using organic solvents, the process comprising:
  - heating a pentite or hexite sugar alcohol or monoanhydrosugar alcohol starting material, with stirring until molten;
  - dehydrating the starting material, under vacuum and while maintaining heat and stirring, in the presence of a solid acid catalyst to produce a dehydrated anhydrosugar alcohol mixture; and
  - purifying the anhydrosugar alcohol.
2. (Cancelled)
3. (Cancelled)
4. The process of claim 1, wherein the solid acid catalyst is an acidic zeolite powder.
5. The process of claim 4, wherein the acidic zeolite powder is selected from the group consisting of CBV 3024, 5534G, T-2665, and T-4480.

6. The process of claim 1, wherein the solid acid catalyst is an acidic ion exchange resin.
7. The process of claim 6, wherein the acidic ion exchange resin is selected from the group consisting of AG50W-X12, Amberlyst 35, Amberlyst 15, RCP21H, and Dowex 50Wx4.
8. The process of claim 6 wherein the acidic ion exchange resin is added in an amount giving from about 0.01 to about 0.15 gram equivalents of resin to sugar alcohol.
9. The process of claim 1 wherein the purification comprises vacuum distillation of the dehydrated anhydrosugar alcohol mixture followed by melt crystallization.
10. The process of claim 1 wherein the purification comprises vacuum distillation of the dehydrated anhydrosugar alcohol mixture followed by a re-distillation.
11. The process of claim 1, further comprising a final separation of the dehydrated anhydrosugar alcohol by centrifugation.
12. The process of claim 1, further comprising a final separation of the dehydrated anhydrosugar alcohol by filtration.
13. A process for the production of an anhydrosugar alcohol; without using organic solvents, the process comprising:
  - heating a pentite or hexite sugar alcohol or monoanhydrosugar alcohol starting material, with stirring until molten;
  - dehydrating the starting material, under vacuum and while maintaining heat and stirring, in the presence of an acid catalyst to produce a dehydrated anhydrosugar alcohol mixture,

wherein the acid catalyst is selected from the group consisting of sulfuric acid, phosphoric acid, p-toluenesulfonic acid, p-methanesulfonic acid, and solid acid catalysts;

vacuum distilling the dehydrated anhydrosugar alcohol mixture to produce an anhydrosugar alcohol distillate;

melt crystallizing the anhydrosugar alcohol distillate to produce a crystallized anhydrosugar alcohol product; and

centrifuging the crystallized anhydrosugar alcohol product to produce an anhydrosugar alcohol.

14. (Cancelled)

15. (Cancelled)

16. The process of claim 58 wherein the solid acid catalyst is an acidic zeolite powder.

17. The process of claim 16 wherein the acidic zeolite powder is selected from the group consisting of CBV 3024, CBV 5534G, T-2665, and T-4480.

18. The process of claim 58 wherein the solid acid catalyst is an acidic ion exchange resin.

19. The process of claim 18 wherein the acidic ion exchange resin is selected from the group consisting of AG50W-X12, Amberlyst 15, Amberlyst 35, RCP21H, and Dowex 50Wx4.

20. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 191°C.

21. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 130°C.
22. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 120°C.
23. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.
24. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.
25. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.
26. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 155°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
27. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 160°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
28. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 165°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

29. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

30. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

31. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

32. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.

33. A process for the production of purified isosorbide, without the use of organic solvents, the process comprising:

heating sorbitol powder at a temperature of about 98°C to about 105°C, with stirring until molten;

dehydrating the melted sorbitol by catalysis with an acidic ion exchange resin, added in an amount giving from about 0.01 to about .15 equivalents, under vacuum pressure of from about 1 Torr to about 10 Torr, and while maintaining stirring and a temperature of from about 98°C to about 191°C, to form an isosorbide mixture;

vacuum distilling the dehydrated isosorbide at a pot temperature of approximately 180°C and a vapor temperature of approximately 170°C, and a vacuum pressure of from about 1 Torr to about 10 Torr, to form an isosorbide distillate;

melt crystallizing the isosorbide distillate by heating the distillate to at least approximately 65°C and then cooling the distillate, over from about 30 minutes to about 45 minutes, to a temperature of about 25°C to about 35°C to form an isosorbide solution having a slurry-like consistency;

centrifuging the isosorbide solution and;

collecting the purified isosorbide.

34. The process of claim 1 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar alcohol starting material is selected from the group consisting of arabinitol, ribitol, sorbitol, mannitol, galactitol, iditol, and mixtures thereof.

35. The process of claim 34 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar alcohol starting material is sorbitol.

36. The process of claim 1 wherein said anhydrosugar alcohol is a dianhydrohexitol.

37. The process of claim 36 wherein the dianhydrohexitol is isosorbide.

38. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 191°C.

39. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 130°C.

40. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 120°C.

41. The process of claim 1 wherein the dehydration is performed at a vacuum pressure from about .01 Torr to about 40 Torr.

42. The process of claim 1 wherein the dehydration is performed at a vacuum pressure of from about .01 Torr to about 10 Torr.

43. The process of claim 1 wherein the dehydration is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.

44. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 155<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

45. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 155<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

46. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 160<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

47. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 160<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

48. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 165<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

49. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 165<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

50. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

51. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

52. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

53. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

54. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

55. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

56. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.
57. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of about 1 Torr to about 10 Torr.
58. The process of claim 13 wherein the acid catalyst is a solid acid catalyst.
59. The process of claim 13 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar starting material is selected from the group consisting of arabinitol, ribitol, sorbitol, mannitol, galactitol, iditol, and mixtures thereof
60. The process of claim 59 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar starting material is sorbitol.
61. The process of claim 13 wherein said anhydrosugar alcohol is a dianhydrohexitol.
62. The process of claim 61 wherein the diahydrohexitol is isosorbide.



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*J. M. Chapman*  
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**Issues**

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**ARGUMENT**

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The claimed invention does not require the use of an organic solvent during the reaction stage. Hartmann teaches only a simple acid catalyzed dehydration and does not teach or suggest the use of a solid acid catalyst without the need for solvent. Moreover, Feldmann *et al.* do not teach that the need for use of a solvent in the dehydration or purification steps can be eliminated. In the claimed process, solvents are not required in either the dehydration or purification steps. Furthermore, unlike Feldmann *et al.*, the claimed invention does not require a concentrated aqueous solution or seed crystals, again eliminating the need for solvent.

While the Examiner asserted that "the skilled artisan in the art would expect to improve on the purity of desired compound by applying the Feldmann *et al.* crystallization technique to the Hartmann process", Hartmann teaches that "[t]he 1,4-3,6-dianhydro-D,L-glucitol (i.e., isosorbide] is of such a nature that it is not readily crystallized, thus *crystallization is not used as a method to purify 1,4-3,6-dianhydro-D,L-glucitol.*" Col. 2, 1. 71-col. 3, 1. 3) (emphasis added). Thus, the teachings of Feldmann *et al.* that crystallization should be used to purify isosorbide directly contradict the teachings of Hartmann that crystallization is *not* to be used as a method to purify isosorbide. Since the teachings of Hartmann contradict the teachings of Feldman *et al.*, one of ordinary skill in the art would not have been motivated to combine the teachings of the two references to develop the process of the present invention. See *W. L. Gore*

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Even assuming, *arguendo*, that one of skill in the art would have been motivated to combine Hartmann and Feldmann *et al.*, he would not have arrived at the claimed invention because he would have used solvents for both the dehydration and purification steps. As set forth above, the claimed process does not use solvents in either the dehydration or purification steps.

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that purification by ion exchange and/or activated carbon, as mentioned in Feldmann et al., requires solvents. The purification step of the claimed process is performed without solvents. As such, Feldmann *et al.* fail to remedy the deficiencies of the cited references, and one of ordinary skill in the art, therefore, would not have arrived at the claimed invention based on Hartmann in view of Feldmann *et al.* and Brinegar *et al.*

Applicants/Appellants respectfully submit that the rejection of claims 1, 4-13 and 16-62 as allegedly unpatentable over Hartmann in view of Feldmann *et al.* (U.S. Patent No. 3,454,603) and Brinegar *et al.* (WO 00/14081) has been overcome and that the Examiner's rejection of those claims under 35 U.S.C. § 103(a) should be reversed.<sup>1</sup>

### CONCLUSION

Applicants/Appellants respectfully await receipt of the Examiner's review of the Amendment and Reply Under 37 C.F.R. § 1.116. In the event that any of the claim amendments therein are entered, Applicant/Appellants will supplement this Brief.

In summary, it is respectfully submitted that the prior art of record as construed by the Examiner renders the present claimed invention obvious to one of skill in the art. For the foregoing reasons, the claims on appeal are patentable over each of the cited references and the teaching of the prior art as a whole. Reversal of the rejections and allowance of the appealed claims are respectfully requested.

Enclosed is our check in the amount of \$330.00 to cover the cost of the filing of the Brief on Appeal. Should there be a deficiency in the filing fee not covered by the enclosed check,

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<sup>1</sup> The Amendment which was filed on December 3, 2003 corrects a misspelling present in claims 34, 35, 59 and 60. The Amendment also cures a lack of antecedent basis rejection raised with respect to claims 16 and 18. The changes to these claims made in the Amendment are not reflected in the attached Appendix.

please charge such deficiency to Deposit Account No. 02-4553. This Brief has been filed in triplicate.

Respectfully submitted,  
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## APPENDIX

The claims listed in this Appendix reflect the status of the claims as they existed after the Final Action. The changes to the claims set forth in Applicant's/Appellants' Amendment and Reply Under 37 C.F.R. § 1.116 in response to the Examiner's Final Action have not been included. Upon entry of Applicant's/Appellants' Amendment and Reply Under 37 C.F.R. § 1.116, Applicants/Appellants will supplement this Appendix with a new set of claims. In light of the above comments, the following claims are set forth as follows:

1. A process for the production of an anhydrosugar alcohol, without using organic solvents, the process comprising:

heating a pentite or hexite sugar alcohol or monoanhydrosugar alcohol starting material, with stirring until molten; dehydrating the starting material, under vacuum and while maintaining heat and stirring, in the presence of a solid acid catalyst to produce a dehydrated anhydrosugar alcohol mixture; and

purifying the anhydrosugar alcohol.

2. (Cancelled)
3. (Cancelled)
4. The process of claim 1, wherein the solid acid catalyst is an acidic zeolite powder.
5. The process of claim 4, wherein the acidic zeolite powder is selected from the group consisting of CBV 3024, 5534G, T-2665, and T-4480.

6. The process of claim 1, wherein the solid acid catalyst is an acidic ion exchange resin.
7. The process of claim 6, wherein the acidic ion exchange resin is selected from the group consisting of AG50W-X12, Amberlyst 35, Amberlyst 15, RCP21H, and Dowex 50Wx4.
8. The process of claim 6 wherein the acidic ion exchange resin is added in an amount giving from about 0.01 to about 0.15 gram equivalents of resin to sugar alcohol.
9. The process of claim 1 wherein the purification comprises vacuum distillation of the dehydrated anhydrosugar alcohol mixture followed by melt crystallization.
10. The process of claim 1 wherein the purification comprises vacuum distillation of the dehydrated anhydrosugar alcohol mixture followed by a re-distillation.
11. The process of claim 1, further comprising a final separation of the dehydrated anhydrosugar alcohol by centrifugation.
12. The process of claim 1, further comprising a final separation of the dehydrated anhydrosugar alcohol by filtration.
13. A process for the production of an anhydrosugar alcohol; without using organic solvents, the process comprising:
  - heating a pentite or hexite sugar alcohol or monoanhydrosugar alcohol starting material, with stirring until molten;
  - dehydrating the starting material, under vacuum and while maintaining heat and stirring, in the presence of an acid catalyst to produce a dehydrated anhydrosugar alcohol mixture,

wherein the acid catalyst is selected from the group consisting of sulfuric acid, phosphoric acid, p-toluenesulfonic acid, p-methanesulfonic acid, and solid acid catalysts;

vacuum distilling the dehydrated anhydrosugar alcohol mixture to produce an anhydrosugar alcohol distillate;

melt crystallizing the anhydrosugar alcohol distillate to produce a crystallized anhydrosugar alcohol product; and

centrifuging the crystallized anhydrosugar alcohol product to produce an anhydrosugar alcohol.

14. (Cancelled)

15. (Cancelled)

16. The process of claim 58 wherein the solid acid catalyst is an acidic zeolite powder.

17. The process of claim 16 wherein the acidic zeolite powder is selected from the group consisting of CBV 3024, CBV 5534G, T-2665, and T-4480.

18. The process of claim 58 wherein the solid acid catalyst is an acidic ion exchange resin.

19. The process of claim 18 wherein the acidic ion exchange resin is selected from the group consisting of AG50W-X12, Amberlyst 15, Amberlyst 35, RCP21H, and Dowex 50Wx4.

20. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 191°C.

21. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 130°C.
22. The process of claim 13 wherein the dehydration is performed at a temperature of from about 98°C to about 120°C.
23. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.
24. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.
25. The process of claim 13 wherein the dehydration is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.
26. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 155°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
27. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 160°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
28. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of from about 165°C to about 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

29. The process of claim 13 wherein the vacuum distillation is performed at a vapor temperature of 170°C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

30. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

31. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

32. The process of claim 13 wherein the vacuum distillation is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.

33. A process for the production of purified isosorbide, without the use of organic solvents, the process comprising:

heating sorbitol powder at a temperature of about 98°C to about 105°C, with stirring until molten;

dehydrating the melted sorbitol by catalysis with an acidic ion exchange resin, added in an amount giving from about 0.01 to about .15 equivalents, under vacuum pressure of from about 1 Torr to about 10 Torr, and while maintaining stirring and a temperature of from about 98°C to about 191°C, to form an isosorbide mixture;

vacuum distilling the dehydrated isosorbide at a pot temperature of approximately 180°C and a vapor temperature of approximately 170°C, and a vacuum pressure of from about 1 Torr to about 10 Torr, to form an isosorbide distillate;

melt crystallizing the isosorbide distillate by heating the distillate to at least approximately 65°C and then cooling the distillate, over from about 30 minutes to about 45 minutes, to a temperature of about 25°C to about 35°C to form an isosorbide solution having a slurry-like consistency;

centrifuging the isosorbide solution and;

collecting the purified isosorbide.

34. The process of claim 1 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar alcohol starting material is selected from the group consisting of arabinitol, ribitol, sorbitol, mannitol, galactitol, iditol, and mixtures thereof.

35. The process of claim 34 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar alcohol starting material is sorbitol.

36. The process of claim 1 wherein said anhydrosugar alcohol is a dianhydrohexitol.

37. The process of claim 36 wherein the dianhydrohexitol is isosorbide.

38. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 191°C.

39. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 130°C.

40. The process of claim 1 wherein the dehydration is performed at a temperature of from about 98°C to about 120°C.

41. The process of claim 1 wherein the dehydration is performed at a vacuum pressure from about .01 Torr to about 40 Torr.
42. The process of claim 1 wherein the dehydration is performed at a vacuum pressure of from about .01 Torr to about 10 Torr.
43. The process of claim 1 wherein the dehydration is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.
44. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 155<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
45. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 155<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
46. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 160<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.
47. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 160<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

48. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of from about 165<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

49. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of from about 165<sup>0</sup>C to about 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

50. The process of claim 9 wherein the vacuum distillation is performed at a vapor temperature of 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

51. The process of claim 10 wherein the vacuum distillation is performed at a vapor temperature of 170<sup>0</sup>C and a pot temperature of at least the distilling point of the dehydrated anhydrosugar alcohol.

52. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

53. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of from about .01 Torr to about 40 Torr.

54. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

55. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of from about 0.1 Torr to about 10 Torr.

56. The process of claim 9 wherein the vacuum distillation is performed at a vacuum pressure of from about 1 Torr to about 10 Torr.
57. The process of claim 10 wherein the vacuum distillation is performed at a vacuum pressure of about 1 Torr to about 10 Torr.
58. The process of claim 13 wherein the acid catalyst is a solid acid catalyst.
59. The process of claim 13 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar starting material is selected from the group consisting of arabinitol, ribitol, sorbitol, mannitol, galactitol, iditol, and mixtures thereof
60. The process of claim 59 wherein the pentite or hexite sugar alcohol or monoanyhdrosugar starting material is sorbitol.
61. The process of claim 13 wherein said anhydrosugar alcohol is a dianhydrohexitol.
62. The process of claim 61 wherein the dianhydrohexitol is isosorbide.